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RESULTS OF CO-FERMENTATION EXPERIMENTS IN HALF INDUSTRIAL SIZE

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ABSTRACT

The research work presented proposes the study of the impact for the qualitative and the quantitative property of the biogas production by the co-fermentation of the bio-fuel industrial by-products and the dangerous liquid pig manure of the concentrated stock of the big pig farms.

The energetic utilization of these materials means more profitable technology for the bio-fuel industry with a longer product course, bigger income for the agricultural enterprises selling the electrical energy, the heat energy, getting support for the demolition of the dangerous materials, savings in the replacement of the plant nutrition with the utilization of the bio-manure, increases the performance of the plant production, making harmless the dung which means a big environmental load.

Because of the profitability of bio-energy utilization depends on the local conditions it is necessary to do experiments to try the available composition of organic wastes in the ratio of the formation in advance. We have to investigate the different ways of technology and recipe of basic and by-products to increase the production

Keywords: sustainable agriculture, environmental protection, energy aimed waste utilisation, increasing the profitability of the agricultural production

INTRODUCTION

The biogas production based on the pork liquid dung, and the other waste of agricultural main product of processing known, and accepted technological procedure in the EU's member states, as the result of which biogas and fermented manure is produced (ARTHURSON, 2009). The quantity and the quality of the raw materials and additives, and the biogas forming in the function of the parameters of the applied technology are strongly variable. The target of my experiments aimed the increasing of the proportion of the renewable energy sources application to increase the methane quantity originating from the various organic matters, to increase of the intensity of the formation, to produce stabile gas content. Making the organic matters polluting the environment harmless is the indirect result of the application of the technology (GOTTSCHALK, 1979). The biogas increasing the greenhouse effect with big methane content means concentrated environmental load and source of danger and on the other hand unutilized energy source on a farming area where the use of the exterior power sources is considerable anyway. While the economy size is his principle from below, the relatively little energy content of the biomass in the view of the transportation expense from above limits the firm concentration (GERARDI, 2003). Because of this it is expedient to examine the energetic utilisation of all possible organic waste at least with laboratory or half firm methods.

MATERIAL AND METHOD

The large-scale manure production modelling of biogas experiments used the liquid pig slurry as raw material. The additive is the Róna sugar sorghum press residue. The industrial by-products and wastes suitable for biogas production are defined by the dry matter, organic matter, nitrogen content, C:N ratio, specific gas yield *(Table 1).*

Table 1. The most important parameters of the input materials influencing the biogas releasing process

Measured parameters	pH value	C/N ratio	Dry matter content (%)	Organic dry matter content
Liquid pig slurry	6.8-7.2	5-10	~4	~3.8
Róna sugar sorghum press residue	-	31-33	42	39

The technology of fermentation experiments in the series progress

At the Engineering and Agricultural Faculty of Szolnok College there is an appropriate, semi-automatic experimental system, representing the operating circumstances, providing similar conditions suitable the formation process of the biogas, regulating change of influencing factors and provide the opportunity of all of necessary measurements of typical data. The liquid pig manure was used during my biogas production experiments as basic substance. The research of appropriate technology may decrease the time of fermentation and the measure of the demolition may improve and the methane content of the forming biogas may be growing.

Table 2. The parameters measured during the experiment series, measuring devices, methods, frequency

Serial number	Measured parameter	Device	Method	Comment
1	fermentor temperature (^{o}C)	digital thermometer		once a day, at the same time
2	gas yield (dm^3)	gasmeter		
3	gas content (%)	GA45 gas analyser		
4	conductivity (mS/cm)	Hydrolab	electrometry	once a day, at the same time
5	soluted oxigen (mg/l)			
6	pH			
7	salination (PSS)			
8	redoxpotential (mV)			
9	BOD5 (mg/l)	Oxi Top 110	pressure dropping	from samples selected based on professional viewpoints
10	COD (mg/l)	NANOCOLOR	photometry	
11	dry matter content (%)	drying cupboard		once a day, at the same time

The supreme features of industrial by-products and wastes suitable for biogas production:

- dry matter-,
- organic matter,
- nitrogen content,
- C:N proportion,
- specific gas yield.

I measured the most important parameters to follow the degradation process (*Table 2*). *Table 3* contains the different treatments in the different process periods.

The technology of fermentation experiments, the process of the experiment series:

a) Loading of laboratory digesters, setting of the treatment combinations
b) Sampling
c) Measurements, examined parameters

We can dose ~50 dm^3 of liquid dung mixture pro treatment to take the factors in connection with the capacity of the fermentors into account. It is possible the simultaneous examination the effect of 9 treatment combinations with in a heat able room placed, periodically mixed, and hermetically closed fermentors. We applied the continuous (filling up), mesophyll system, which is most widespread in the practice, it can be reproduced the process sections, as the launching, load change, receipt change, according to certain expert opinions each single daily measurement combination for a separate experiment can be qualified (KALMÁR ET AL., 2003).
We divided the process of the fermentation into sections according to *Table 3*.

Table 3. Technology of co-fermentation experiments

Serial number	1.	2.	3.	4.
period of the process	stabilization	refilling period with fresh substance	running-up period	comparative experiments
treatment		running-up period with fresh substance		
duration time	7 days	14 days	21 days	21 days

The statistical methods used for the evaluation of co-fermentation experiments
I used for the statistical analysis Excel spreadsheet and SPSS for Windows 18.0. The data were analysed by variance with independent two-T sample. I examined the homogeneity with Levene test. By the group pair comparison I used Tamhane test in the case of heterogeneity, and LSD test in the case of homogeneity. The relationship between variables was performed with correlation analysis tests (Pearson's correlation coefficient) and linear regression analysis.

RESULTS

Examining the gas production of the reactors it is verifiable that much less biogas was produced in the untreated control in the given period, besides given parameters than in the other two, on pork liquid dung basis, with vegetal by-products added. The sugar sorghum bagasse (press residue) used as additive increased the specific biogas yield more than two times in the experiment *(Figure 1).* In the concern of bacteria treated fermentor verifiable, that the bacterium culture bred between the laboratory circumstances did not increase significantly the production of the biogas or the methane *(Table 4)*. His effect appeared in the faster running-up of the gas production. In the case methanogen bacteria not containing fermentors filled up with pork liquid dung the biogas production after the vaccination under very short time, started up inside 1–2 days.

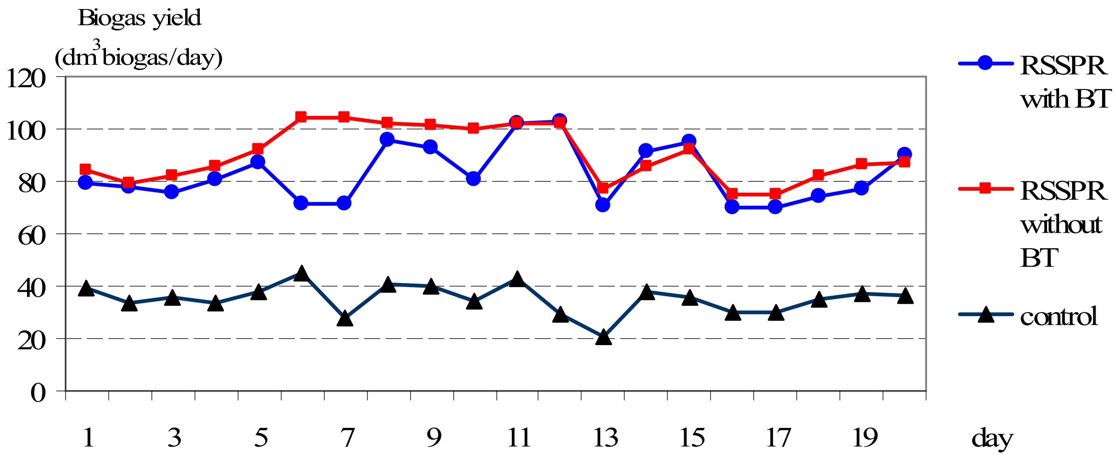

Figure 1. Biogas yield of the fermentors during the comparative period of the experiment (RSSPR=Róna Sugar Sorghum Press residue added, BT-bacteria treatment) on liquid pig dung basis

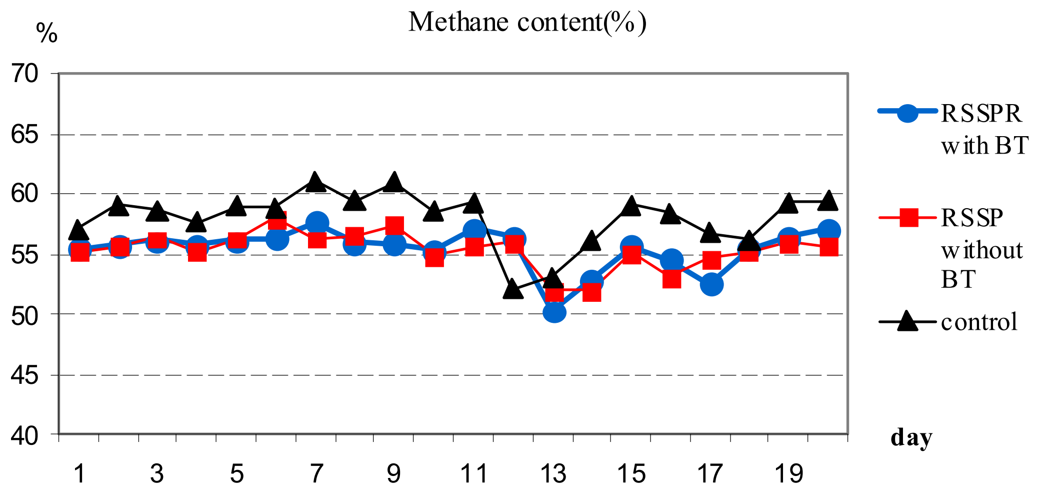

Figure 2. Methane content of the released biogas during the comparative period of the experiment (RSSPR=Róna Sugar Sorghum Press residue added, BT-bacteria treatment) on liquid pig dung basis

The methane content almost parallel oscillated between 50-60% in all fermentors *(Figure 2)*. There was no significant difference among the data of the Róna Sugar Sorghum Press residue treated (55.4%) with or without bacteria and the control fermentor (58.6%).

Table 4. Average biogas yield of liquid pig dung and sugar sorghum press residue added fermentors

Actual production value compared to the control	control fermentor		Róna sugar sorghum press residue added			
			without bacteria treatment		with bacteria treatment	
Treatment to assure the perfect DMC	200 g*		200 g**		200 g**	
Average biogas production (dm^3/day;%)	35.2	100	90.0	257	84	238
Methane content (%)	58.6	100	55.4	94.5	55.4	94.54

* 200 g DMC liquid pig slurry overloaded
** 100 g DMC liquid pig slurry and 100 g DMC additive mix overloaded

The Róna sugar sorghum press residue addition increased the biogas production about 2.5 times compared to the biogas releasing of the control experiment but the methane content decreased only ~3% *(Table 4)*.

From the proportion of the methane measured in the course of our experiments representing half industrial circumstances it is verifiable, that the ratio of the methane is changing according to the intensity of the gas development (*Figure 2*).

CONCLUSIONS

We simulated topping up (continuous) technology with 20 days Hydraulic Retention Time in mesophyll circumstances, that's why we emptied 5% digested effluent substrate and fill up 5% influent row pig sludge into the control fermentor, and the same amount of liquid pig slurry and the by-product of bio-fuel industry sugar sorghum press residue with or without bacteria treatment. To summarize the results we can prove, that the 100 g DMC bagasse additive increased the biogas production almost 2.5 times in the about 2000 g DMC contained liquid manure. On the contrary the methane content didn't decreased significantly, only 3% was the declining. The produced biogas is utilisable for energetic aims.

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